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NATIONAL COMMUNICATIONS

COMMUNICATIONS FROM PARTIES INCLUDED IN ANNEX I TO THE CONVENTION

First compilation and synthesis of second national communications from Annex I Parties

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Executive summary

1. The present report includes information on 18 Parties that submitted their second national communication by 15 August 1997 (15 Annex II Parties, two Parties with economies in transition and Monaco) accounting for 59 per cent of total 1990 greenhouse gas (GHG) emissions from Annex I Parties. Total GHG emissions of these 18 Parties taken together increased from 1990 to 1995 by about 1.7 per cent, although the trend in total GHGs emissions varied amongst Parties. For the nine Parties with increased emissions, which in 1990 accounted for 42 per cent of total GHG emissions from Annex I Parties, the growth ranged from 1 to 10 per cent over the 1990 level. For five Parties, whose total 1990 GHG emissions represented 13 per cent of emissions from Annex I Parties, emissions were lower in 1995, ranging from 21 to 4 per cent below the 1990 level (the largest reductions being reported by Parties with economies in transition). For three Parties emissions in 1995 were approximately the same as in 1990.

2. Carbon dioxide (CO_2) emissions in 1995 increased in the majority of reporting Parties compared to 1990, the range of increase being from 2 to 10 per cent. For the five Parties with decreasing CO_2 emissions the range of reduction was from 2 to 22 per cent compared to the 1990 level. The trends in emissions from 1990 to 1995 for methane (CH_4) and nitrous oxide (N_2O) varied among the reporting Parties, with the majority of them reporting lower emissions of CH_4, and about half reporting lower emissions of N_2O. Most Parties reported emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), although not uniformly. For the majority of reporting Parties PFC emissions were substantially lower in 1995 in comparison to 1990. Emissions of SF_6 increased over those of 1990 for all reporting Parties except two. Emissions of HFCs have increased significantly since 1990, with many Parties remarking on the increasing use of HFCs as replacements for ozone-depleting substances. For all the Parties reporting emissions of HFCs, the increase in emissions in percentage was greater than for any other GHG.

3. From 1990 to 1995 for the reporting Parties as a whole the relative shares of the main greenhouse gases did not change significantly, although for some individual Parties there were shifts in the shares, particularly on account of decreasing CH_4 and/or N_2O emissions. For all Parties except one, the largest share of total GHG emissions was CO_2, accounting for 83 per cent of total 1995 GHG emissions of the Parties. Methane held the second largest share (11 per cent) of GHG emissions, followed by N_2O (4 per cent). The relative importance of the other greenhouse gases (HFCs, PFCs and SF_6) increased over the period 1990 to 1995, from 1.3 to 1.8 per cent of total GHG emissions.

4. Parties were consistent in reporting emissions from those main source and sink categories which in 1990 accounted for about 98 per cent of their total GHG emissions expressed in CO_2 equivalent, using 1995 Intergovernmental Panel on Climate Change (IPCC) global warming potentials (GWP). For 83 per cent of the total 1990 GHG emissions the highest confidence level was reported. Other sources having high or medium confidence levels accounted for an additional 13 per cent of emissions. When the emission estimates are compared over a period of time, the resulting relative confidence level is generally higher than for the estimates for individual years.

The fact that 96 per cent of emissions were reported as having a high or medium confidence level may therefore be regarded as an adequate basis for assessment of implementation of Article 4(a) and (b).

5. The largest source of total GHG emissions and of CO_2 emissions was fuel combustion (83 and 97 per cent respectively). The bulk of these emissions were produced by the energy and transformation and transport sectors, with emissions from these two sectors alone accounting for more than half of total GHG emissions in 1995 (29 and 24 per cent, respectively). The second largest source of GHG emissions was agriculture (5.4 per cent), followed by industrial processes (5 per cent) and waste (4 per cent). The main source of methane (CH_4) emissions was agriculture (35 per cent), followed by waste (32 per cent in 1990, 34 per cent in 1995) and fugitive fuel emissions (29 per cent in 1990, 27 per cent in 1995). Agriculture was the largest (39 per cent) source of nitrous oxide (N_2O) emissions, followed by industrial processes (35 per cent in 1990, 32 per cent in 1995) and fuel combustion (22 per cent in 1990, 26 per cent in 1995).

6. The fastest growing source of CO_2 emissions for the majority of Parties was transport, where emissions were increasing even for some of those Parties which in 1995 registered lower levels of total CO_2 emissions than in 1990. The fastest growing, or least declining, source of CH_4 emissions for about half of the Parties was waste, while the fastest growing source of N_2O emissions for the majority of Parties was fuel combustion, mostly for transport purposes, as a consequence of growth in the sector as well as the introduction of catalytic converters.

7. In general, the quality of the inventory data presented in the second national communications was higher than in the first communications, but some problems which hamper reporting of GHG inventories in a transparent, complete and consistent manner still exist. The revised guidelines for the preparation of national communications by Annex I Parties require further improvement to resolve these problems.

8. The rationale for the majority of measures reported in the second national communications was mainly economic, particularly for energy efficiency measures, with mitigation of climate change being an important but not a primary objective. The spectrum of policies and measures employed by reporting Parties includes economic instruments, particularly taxes, regulations, information, education and raising public awareness. Voluntary approaches figured predominantly in a number of second communications. Many of these partnership arrangements are with industry and aim to reduce GHG emissions per unit of production.

9. The main focus was on policies and measures to curb CO_2 emissions. Energy end-use in the residential, commercial and institutional as well as industrial and energy transformation sectors remained the primary target areas of CO_2 mitigation measures. A majority of Parties include energy market restructuring as an important policy which has implications for GHG emissions, though emissions reduction is not the primary purpose of the reforms. A number of Parties are in the early phases of market restructuring and describe the uncertainty of structural developments in terms of fuel choice, investment and trade patterns, and the implications for CO_2 emissions. Few, if any, measures aim to influence the rate of capital stock turnover. Rather, the general approach is to encourage the choice of efficient equipment, appliances and processes when new investments are made. In a similar vein, regulations and standards for buildings generally are applied to new

construction and much less frequently to renovations. Across the range of communications, both the measures reported and the monitoring data illustrated the difficulties that Parties face in limiting transportation emissions. Many Parties made reference to the strong link between economic development and transport demand growth. The measures described by most Parties and their projected effects demonstrate that reducing emissions from the transport sector remains a significant challenge.

10. Most reporting Parties indicated that the effectiveness of policies and measures directed at CO_2 emissions will increase significantly with time. A similar trend is evident with respect to CH_4 emissions. Policies and measures targeted at N_2O emissions, however, are expected to achieve virtually all of their emission reductions by the year 2000. Although the estimates provided by most Parties for the effect of individual policies and measures would lead to the conclusion that CO_2 emissions in 2000 will be up to 11 per cent lower than in 1990, in actual fact this trend is often projected to be offset by the growth in CO_2 emissions from some sources. Most reporting Parties expect their policies and measures to reduce CH_4 emissions by an amount equivalent to 10-20 per cent of 1990 levels, while the coresponding target for N_2O policies and measures is usually a reduction of more than 30 per cent.

11. Compared with first national communications, projections presented by all reporting Parties were of higher quality. Generally, Parties included enough information to provide a qualitative understanding of the key assumptions used to develop projections, especially for energy-related CO_2 emissions, which constitute the bulk of total GHG emissions of reporting Parties. For projection purposes, four Parties adjusted their base year figures upwards to account for climatic anomalies in the base year. These Parties provided information on the methods used in a transparent manner.

12. Ten Parties accounting for 44 per cent of the 1990 CO_2 emissions from Annex I Parties, projected an increase in these emissions to 2000. Seven Parties, whose contribution to the 1990 inventory amounted to 15 per cent, projected stabilization or decrease in CO_2 emissions for 2000 compared to the base year levels. The long-term projections of CO_2 emissions up to 2020 presented by ten Parties indicated that almost all of them expect a further growth of their CO_2 emissions above the 2000 level.

13. Thirteen Parties, accounting for 45 per cent of the aggregated Annex I inventory figures for 1990, projected stabilization or decreases in CH_4 emissions compared to their base years. Eight Parties, accounting for 43 per cent of the 1990 aggregated inventory figures for Annex I Parties projected a stabilization or decrease in N_2O emissions compared to their base years. Long-term projections for both CH_4 and N_2O have trends similar to those for 2000. Parties that made HFC projections for 2000 expect a considerable growth, while PFC projections show a decreasing trend. SF_6 emissions are projected to grow for all reporting Parties but two. For 2020, emissions of all these gases are projected to increase and their importance relative to other gases will also grow.

14. When all projected emissions (excluding land-use change and forestry) are totalled using IPCC-1995 GWPs, nine of the reporting Parties projected an increase for 2000. Six Parties projected a decrease. Projections to 2020 revealed a different pattern: only two Parties projected

a decrease, while the other eight Parties projected an increase, five of them of more than 25 per cent.

15. A comparison of projections for 2000 presented in the second national communications with inventories for the base year and the latest reported year, continues to suggest that for the majority of the reporting Parties additional measures would be needed to return CO_2 emissions to their 1990 level by 2000. Achieving the 1990 levels is more likely for CH_4 and N_2O emissions, which are projected to decrease in most of the reporting Parties. The emissions of other GHGs (HFCs, PFCs, SF_6) are expected to grow significantly, especially after 2000. Long-term projections presented by Parties indicate that similar trends in GHG emissions are expected beyond 2000 up to 2020. The increase of total GHG emissions in this period, expressed in CO_2 equivalent, is projected to be even larger than for the period 1990-2000 for most of the reporting Parties

I. INTRODUCTION

16. The present report covers 17 (out of 35) Annex I Parties, which submitted their second national communication to the secretariat before 15 August 1997[1]. These Parties are: Austria (AUT), Belgium (BEL), Canada (CAN), the Czech Republic (CZE), Finland (FIN), France (FRA), Germany (DEU), Iceland (ICE), Ireland (IRE), the Netherlands (NLD), New Zealand (NZL), Norway (NOR), Slovakia (SLO), Sweden (SWE), Switzerland (CHE), the United Kingdom of Great Britain and Northern Ireland (GBR) and the United States of America (USA). Monaco (MON)[2], though not an Annex I Party, has submitted its second national communication according to its declared intention to be bound by Article 4.2 (a) and (b) of the Convention; this communication is also considered in the present report.

17. Since the present report considers information from 18 Parties only, the following discussion should be considered as preliminary, pending submission, analysis and compilation of data from the second national communications of the remaining Annex I Parties. The secretariat intends to prepare the full compilation and synthesis of second communications when they have all been received, presumably for the fourth session of the Conference of the Parties.

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[1]According to decision 9/CP.2, Annex I Parties had to submit a second national communication by 15 April 1997. Parties with economies in transition should submit their second communication no later than 15 April 1998. For decisions of the Conference of the Parties at its first session, see FCCC/CP/1995/7/Add.1; for those of the second session, see FCCC/CP/1996/15/Add.1).

[2]Since Monaco submitted only limited information in its national communication this Party is not considered in the discussion of projections and methodological issues related to inventories.

18. This document generally follows the structure and approach used in the previous compilation and synthesis of first national communications from Annex I Parties (FCCC/CP/1996/12 and Add.1 and 2). However, owing to time constraints and late submissions of some of the second national communications it was not possible to cover the subjects to the same degree of detail as in the previous report. Instead, the secretariat has chosen to focus on those issues which reflect the recent developments or contain some new information or data, in particular those reported for the first time according to the revised guidelines. Some sections have been omitted either because they would not have provided substantially new information (e.g. national circumstances or research and systematic observation), or are covered in separate documents (e.g. finance and technology issues, see FCCC/SBSTA/1997/13, or activities implemented jointly, see FCCC/SBSTA/1997/12 and Add.1), or are intended to be separately discussed in the future (e.g. raising public awareness). These omissions will be rectified in the future full compilation and synthesis report.

19. The present document consists of two parts: a report containing narrative text and illustrative tables, and an addendum containing the numerical data for inventories of anthropogenic emissions and removals and projections for 2000 and up to 2020 (FCCC/SBI/1997/19/Add.1). Methodological issues related to inventories of greenhouse gas (GHG) emissions are discussed in the annex to this document, which also contains some suggestions aimed at further improving development and reporting of national GHG inventories.

20. For the sake of brevity the names of Parties are sometimes given using their ISO three-letter codes. The revised 1996 Intergovernmental Panel on Climate Change (IPCC) guidelines for national GHG inventories are hereafter referred to as the IPCC guidelines, and the revised guidelines for the preparation of national communications from Annex I Parties (annex to decision 9/CP.2, FCCC/CP/1996/15/Add.1) as the FCCC guidelines. Categories of sources of GHG emissions or their sinks corresponding to the IPCC guidelines' nomenclature are given in *italics*. Blanks in the tables generally indicate that no data were available.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS OF GREENHOUSE GASES FOR 1990 TO 1995

21. Inventory data submitted by 18 reporting Parties for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), emissions from international bunkers, other GHGs, ozone precursors and sulphur dioxide (SO_2) for 1990 and 1995 appear in tables A.1 to A.12 in the addendum (document FCCC/SBI/1997/19/Add.1). Estimates of CO_2 removals are reported separately from emissions owing to the differences in reporting of *land-use change and forestry* among Parties. The trends in total emissions, as well as for CO_2, CH_4 and N_2O, and the trends for the most important sources for 1990 to 1995, are included in tables B.1 to B.16.

22. The total GHG emissions in 1995 for the 18 Parties considered in this document represent only about 60 per cent of the total GHG emissions for the 31 Parties considered in the second compilation and synthesis report on first national communications. Total GHG emissions

increased from 1990 to 1995 for about half of the Parties, and for all reporting Parties combined total GHG emissions increased from 1990 to 1995 by about 1.7 per cent.

Box 1. CO_2 and N_2O emissions from the transport sector

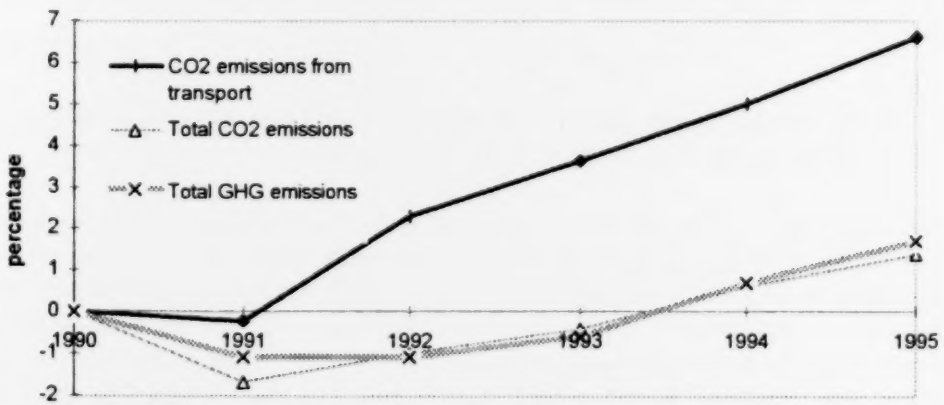
The trend in CO_2 emissions from transport was practically homogenous among Parties. Of the 16 Parties reporting emissions from transport, 13 reported increased emissions in 1995 relative to 1990, ranging from 2 to 27 per cent, with the average increase being 11 per cent. For the three Parties which had lower emissions in 1995 than in 1990, emissions have not necessarily been decreasing throughout the six-year period. For Switzerland and Finland, emissions apparently fluctuated around levels of 1990, and for Slovakia, although a downward trend was evident in the years immediately following 1990, in recent years emissions have begun to rise.

The majority of Parties reported increased emissions of N_2O from transport, largely due to the introduction of catalytic converters in recent years. Although the share of these emissions in total N_2O emissions is only 15 per cent, and less than 1 per cent of total GHG emissions, these emissions have grown substantially, more than 35 per cent, since 1990.

Not only have emissions from transport been increasing, for the majority of Parties they have been increasing faster than emissions from other sources. As a result, the contribution of transport to total greenhouse gases emissions has increased from 22 per cent in 1990 to 24 per cent in 1995.

For most of the reporting Parties, the bulk of transport emissions are on account of gasoline consumption by automobiles and other vehicles, while diesel and jet fuel consumption are responsible for a much lower share of emissions.

Trends in CO_2 emissions from transport, total CO_2 emissions and total GHG emissions



23. CO_2 was the most important anthropogenic greenhouse gas for the reporting Parties, representing 83 per cent of total GHG emissions in 1995. *Fuel combustion* was the largest source of CO_2 emissions, 97.1 per cent, with the majority of these emissions coming from the *energy and transformation industries* and *transport* (35 and 29 per cent, respectively). For half of the reporting Parties the *energy and transformation industries* accounted for 53.4 per cent (Czech Republic) to 33.0 per cent (Netherlands) of CO_2 emissions from *fuel combustion*. The share of the *transport* sector ranged from 50.5 per cent (Norway) to 7.1 per cent (Czech Republic). For six Parties (AUT, FRA, ICE, NOR, NZL, SWE), this sector was the most important source of CO_2 emissions.

24. *Fuel combustion* remained the largest source of CO_2 emissions, representing 97.1 per cent of the total. *Industrial processes* accounted for 2.3 per cent. For 13 Parties, CO_2 emissions from *fuel combustion* represented more than 90 per cent of the total CO_2 emissions. For six of them (CZE, DEU, FIN, GBR, NLD, USA) this share was higher than 95 per cent, the United States of America having the highest value among them with 98.7 per cent. For Austria, Iceland, Monaco, New Zealand and Norway, the *fuel combustion* share was lower, ranging from 60 per cent (MON) to 88 per cent (NZL). These four Parties (i.e. except Monaco), reported higher shares of *industrial processes* emissions (18.2, 18.6, 10.0 and 18.4 per cent, respectively). These higher CO_2 emissions in the *industrial processes* category are apparently due to the fact that emissions from the iron and steel industry were included in this category, not in *fuel combustion* as is usually the case.

25. For the majority of Parties total CO_2 emissions in 1995 were higher than in 1990, with increases ranging from 2 to 10 per cent. Five Parties (CHE, CZE, DEU, GBR, SLO) in 1995 reported emissions 2 (CHE) to 22 per cent (SLO) lower than in 1990. Emissions from *fuel combustion* have increased since 1990 for the majority of Parties, with *transport* being the fastest growing source. For 13 Parties this increase in transport emissions was in a range from 2 (GBR) to 27 per cent (IRE). Three Parties (CZE, DEU, GBR) with overall decreasing CO_2 emissions nevertheless reported increases from *transport*. For 11 out of 14 Parties CO_2 emissions from *international bunker* fuel increased compared to 1990, with increases ranging from 10 (NLD) to 36 per cent (AUT). For the majority of reporting Parties CO_2 emissions from *international bunkers* were equivalent to 1 to 6 per cent of total CO_2 emissions; in Iceland and Netherlands they were equivalent to 17 and 24 per cent, respectively. Table 1 shows the percentage change in CO_2 emissions from 1990 to 1995 for the major sources.

Table 1. Percentage change in CO_2 emissions from the major sources (1995 vs. 1990)

	CO_2 source		
	Transport	Stationary combustion	Industrial processes
Austria	13.7	-1.4	-11
Belgium	9.4	2.5	13.8
Canada	7.5	8.5	13.9
Czech Republic	12	-23.9	-23
Finland	-3.2	7.1	-30
France	7.8	-4.1	-4.6
Germany	7.6	-15.6	-8.4
Iceland	3.9	7.6	8.7
Ireland	27.1	7.2	8.9
Monaco			
Netherlands	12.3	8.9	8.1
New Zealand	25.5	-5.1	14.6
Norway	5	9.4	7
Slovakia	-18.4	-19.9	-10.4
Sweden	3.7	4.2	17.7
Switzerland	-0.6	-0.4	-22.1
United Kingdom	1.6	-10.5	-10.9
United States			12.3

26. Total 1995 CH_4 emissions reported by 18 Parties represent only 52 per cent of the aggregated CH_4 emissions of Annex I Parties in 1990. The largest sources of methane emissions for all reporting Parties in 1995 were *waste* and *agriculture* (each responsible for 35 per cent), followed by *fugitive fuel* emissions (27 per cent). For six Parties (AUT, DEU, FIN, GBR, NOR, USA) *waste* was the most important source of CH_4 emissions ranging from 69 per cent for Norway to 36 per cent for the United States of America. *Fugitive fuel* emissions also represented a significant share of total CH_4 emissions for some Parties. For Canada and the Czech Republic this category was the largest source, representing 48.0 and 55.2 per cent, respectively.

27. The trends in CH_4 emissions for 1990 to 1995 varied by source and Party. In comparison to 1990 three Parties reported increases and twelve decreases in total emissions in 1995. Of the three main sources, five Parties reported increasing *fugitive fuel* emissions, three Parties increases from *agriculture* and eight Parties increases from *waste*. For eight Parties *waste* was the fastest

growing (or least declining) source of CH_4 emissions, while *fugitive fuel* emissions grew the fastest for six Parties and emissions from *agriculture* the fastest for three Parties (table 2).

Table 2. Percentage change in CH_4 emissions from selected sources (1995 vs. 1990)

	CH_4 source		
	Fugitive fuel emissions	Agriculture	Waste
Austria	21.5	0.4	-3.3
Belgium	-15.8	0.3	5.9
Canada	27.9	11.9	-5.8
Czech Republic	-11.9	-31.9	-2.9
Finland		-12.9	5.6
France	0.1	-4.6	-15.2
Germany	-25.1	-18.8	1.6
Iceland	0	-6.7	21.1
Ireland	8.9	-0.5	1.5
Monaco			
Netherlands	-4.7	-5.8	0
New Zealand	10.2	-3.5	-15.1
Norway	42.9	5.5	6.6
Slovakia	-12.3	-34.8	-3.1
Sweden		-1.5	-28.2
Switzerland	-12.7	-2.2	-3
United Kingdom	-35.1	-3.4	-7.2
United States	-6.2	9.5	15

28. *Agriculture* accounted in 1995 for the largest share, 39.3 per cent, of the aggregate N_2O emissions of the reporting Parties, followed by *industrial processes*, 31.8 per cent and *fuel combustion*, 26.3 per cent. For ten Parties (CHE, DEU, FIN, ICE, IRE, NLD, NOR, NZL, SLO, USA) *agriculture* (fertilizer use) was the largest source of N_2O emissions in 1995, while emissions from *fuel combustion* and *industrial processes* were the largest source for four (AUT, CAN, CZE, SWE) and three (BEL, FRA, GBR) Parties, respectively.

29. As with CH_4, the trend in N_2O emission varied by Party and source. The percentage change in emissions ranged from 38 per cent below to 25 per cent above 1990 emission levels in 1995,

with about half the Parties reporting increased emissions. Most Parties reported increased emissions from *fuel combustion*, largely from *transport*, with increases of more than 20 per cent for eight Parties. As is shown in table 3, for 14 Parties, *fuel combustion* was also the fastest growing source of N_2O emissions. Only three Parties reported increased N_2O emissions from *industrial processes*, while for six Parties emissions from this sector decreased by more than 10 per cent. Likewise, only four Parties indicated increases in emissions from *agriculture*.

Table 3. Percentage change in N_2O emissions from selected sources (1995 vs. 1990)

	N_2O source		
	Fuel combustion	Industrial processes	Agriculture
Austria	27.8	-8.3	0.6
Belgium	8.7	7	-0.8
Canada	53.9	0.3	20.9
Czech Republic	-18	3	-26.1
Finland	20	0	-10.4
France	17.6	-10.7	-3.4
Germany	13.5	-2.4	-10.4
Iceland	75	-12.5	-13.6
Ireland	27.1	0	-18.1
Monaco			
Netherlands	52.7	-2.7	21.2
New Zealand	-4.8		-1.7
Norway	0	-28.6	0
Slovakia	33.3	-47.6	-43.2
Sweden	7.9	-15.9	0
Switzerland	46	-3.1	-4.2
United Kingdom	41.5	-32.2	-6.7
United States	11.4	10.9	7.8

30. Most of the Parties reported emissions of the "new" gases, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). For the majority of Parties emissions of PFCs have decreased since 1990, while emissions of HFCs and SF_6 have increased, HFCs in particular, owing to their use as a replacement for ozone-depleting substances controlled by the Montreal Protocol on Substances that Deplete the Ozone Layer. For all Parties reporting

emissions of HFCs, the increase in percentage was greater than for any other GHG. In 1995 these "new" gases accounted for 1 to 6 per cent of total GHG emissions for nine Parties (table 4).

Table 4. Total emissions of the "new gases" and their relative share, 1995

	Total emissions of HFCs, PFCs and SF_6 (gigagrams of CO_2 equivalent)	Percentage of total greenhouse gas emissions
Austria	8	negligible
Canada	8 408	1.4
Czech Republic	1	negligible
Germany	10 543	1
Iceland	74	2.7
Netherlands	12 302	5.2
New Zealand	4 749	5.9
Norway	2 259	4.2
Slovakia	321	0.6
Sweden	1 828	2.6
Switzerland	1 043	1.9
United Kingdom	3 927	0.6
United States	136 669	2.2

31. The largest share of total GHG emissions expressed in CO_2 equivalent was that of carbon dioxide, accounting for 83 per cent. CH_4 and N_2O accounted for 11 per cent and 4 per cent of total emissions, while emissions of HFCs, PFCs and SF_6 taken together were 1.8 per cent of total emissions. From 1990 to 1995 the relative shares of the gases did not change significantly, with the exception of HFCs, PFCs and SF_6.

32. The trend in total GHG emissions varied among Parties. For nine Parties (BEL, CAN, FIN, IRE, NLD, NOR, NZL) overall GHG emissions increased by 1 to 10 per cent over those of 1990. Total GHG emissions were down from 1990 for five Parties (CZE, DEU, GBR, ICE, SLO), in proportions ranging from 21 to 4 per cent. Three Parties (AUT, CHE, FRA) reported that their emissions in 1995 were approximately on the same level as in 1990. For all reporting Parties, emissions in 1995 were 1.7 per cent above the 1990 level.

III. POLICIES AND MEASURES TO LIMIT ANTHROPOGENIC EMISSIONS AND PROTECT AND ENHANCE SINKS AND RESERVOIRS OF GREENHOUSE GASES

33. The rationale for the majority of measures reported in the second (as well as in the first) national communications was mainly economic, particularly for energy efficiency measures, with mitigation of climate change being an important but not a primary objective. The spectrum of policies and measures employed by reporting Parties includes economic instruments, particularly taxes, regulations, information, education and raising public awareness. Voluntary approaches figured predominantly in a number of second communications. Many of these partnership arrangements are with industry and aim to reduce GHG emissions per unit of production.

34. The main focus was on policies and measures to curb CO_2 emissions. Energy end-use in the residential, commercial and institutional as well as industrial and energy transformation sectors remained the primary target areas for CO_2 mitigation measures. Policies and measures which aim to improve energy efficiency are pivotal in all of the second national communications received so far.

35. National circumstances such as natural resource endowment, political and economic structures, and geographic position influence the type and the array of measures implemented. In general there are no significant shifts in focus or approach from the polices and measures described in the first national communications. These measures were described in detail in the second compilation and synthesis report (FCCC/CP/1996/12/Add.1). In the limited available time, it was not possible to describe policies and measures in a comprehensive manner for all major sectors and gases.

A. Reporting

36. In general, polices and measures in the second communications were reported in a clearer manner than in the first ones. Notably, the communications received so far provide more information on the estimated effects of measures. Many communications describe policies and measures in a transparent fashion, although this is not always the case. All reporting Parties provided a description of the policies and measures they have adopted to implement their commitments under Article 4.2 (a) and (b). The manner in which policies and measures were reported varied significantly from Party to Party both in detail and approach.

37. Some Parties reported more than one hundred measures. This quantity complicated their description and analysis significantly. It might be advisable to develop some criteria for reporting policies and measure in national communications, which on the one hand would limit their number to a manageable optimum, and on the other hand would highlight those measures which make a substantial contribution to national climate change policies.

38. The FCCC guidelines request that, to facilitate transparency, enough detail should be provided about each policy and measure in the text of the national communication to allow a third party to understand:

- Its objective in terms of the target gas and sector;
- The type of policy instrument used;
- Its status of implementation;
- How it is expected to function and interact with other measure; and
- Indicators of progress.

39. The FCCC guidelines, *inter alia*, establish that the elements listed above should be set out in a uniform policies and measures summary table. The table provides a structured format for summarizing policies and measures including: type of instrument, status, estimate of mitigation impact and monitoring. Given the heterogeneous nature of information on policies and measures, it also serves to enhance transparency. The guidelines also call for Parties to indicate in the summary tables the measures that are not included in the baseline projection. From the information provided, it was not clear to what extent this guidance had been followed. Ten Parties (AUT, CAN, CHE, DEU, FIN, GBR, IRE, NLD, NZL, SLO) included the summary tables, though the degree of information provided varied considerably both in coverage and level of detail.

40. Another element of the reporting guidelines, monitoring, was dealt with in a variety of manners or not at all by Parties. Annual statistics are referred to as the most common indicator of intermediate progress. Several Parties listed interim targets. It was not possible to discern clear trends of intermediate indicators of progress from the data provided.

41. Information on the cost of a policy or measure was provided for only a few measures. A number of reporting Parties quoted government budget allocations for particular measures or programmes. Some included the estimated economic benefits of particular measures, such as energy cost savings or cost estimates of technology penetration.

42. The revised guidelines request information on policies and practices which encourage activities that lead to greater levels of GHG emissions not controlled by the Montreal Protocol than would otherwise occur. A few Parties included separate sections discussing this issue (e.g. CHE, NLD). Many Parties mentioned in this regard the substitution of chlorofluorocarbons (CFCs) by HFCs.

B. General characteristics of policies and measures

43. Parties' strategies to mitigate GHG emissions have not changed considerably from policies and measures described in the first national communications. There has been some strengthening of measures, e.g. increases in fuel and energy taxes (e.g. AUT, GBR, SWE), adoption of tighter building codes (e.g. CHE, CZE, IRE) and regulation of waste management. Measures also have been eliminated or scaled down, generally because of insufficient funding or shifts related to

market reform (e.g. GBR, USA). The largest number of measures and those that are projected to make the largest contribution to reducing total GHG emissions in 2000 and beyond still target CO_2 emissions. The most frequently reported policies and measures are summarized below.

Summary of the most frequently reported policies and measures

Carbon dioxide

Energy and transformation industries

* Air pollution regulations
* Efficiency improvements in production, transmission and distribution
* Promotion of renewable energy sources and technology
* Energy market reform

Industry and residential/commercial/institutional

* Energy and fuel prices and taxes
* Regulations and standards for standing stock and some traded goods
* Voluntary approaches to improve energy efficiency
* Information and education
* Tax incentives or subsidies for efficient equipment

Transportation

* Fuel and vehicle taxes
* Voluntary approaches or standards to improve average vehicle fuel efficiency
* Air pollution regulations
* Promotion of public transport and modal shifts for freight carriage
* Behaviour modification, e.g. consumer education, road pricing

Methane

* Agriculture and energy sector policy reform
* Waste stream reduction and incineration
* Gas recovery from landfills and sewage treatment plants

Nitrous oxide

* Improved efficiency in the production and application of nitrogen fertilizers
* Process modification in adipic acid manufacturing

C. Measures targeting carbon dioxide

1. Energy and transformation

44. The *energy and transformation* sector includes activities related to the exploration and production of energy resources, transformation from primary to secondary forms such as burning coal to produce electricity and distribution to end-users. For many Parties this sector is the single largest source of CO_2 emissions. It accounted for 36 per cent of CO_2 emissions from all Annex I parties in 1990 and for 34 per cent in 1995.

45. A majority of Parties include energy market restructuring as an important policy which has implications for GHG emissions, though emissions reduction is not the primary purpose of the reform. Energy and fuel price liberalization is viewed as a significant bottleneck to effective climate change policy measures in Slovakia. In the United Kingdom, electricity market liberalization is expected to have a large impact on CO_2 emissions in 2000 and beyond. There, competition in electricity generation has spurred shifts from coal and oil to natural gas, which is burned in high efficiency units, and increased productivity in nuclear plants. Along with the market liberalization, regulations set a guaranteed market for alternative electricity generation, e.g. from renewables, combined heat and power (CHP) and waste.

46. While market liberalization has favourable CO_2 implications for the United Kingdom, a number of Parties reported uncertainty related to sector reform and its impact on their GHG emissions (e.g., CHE, FIN, FRA, NZL, SWE). Descriptions include the potential up- and down-sides of market restructuring in relation to GHG emissions. Some Parties indicated that competition in electricity generation decreases the attractiveness of large central power stations, which may imply less coal burning and CO_2 emissions, but also less nuclear power with its low GHG emissions profile. It may also lower the market entry barriers for CHP and renewables. Market reform often translates into lower consumer prices which can encourage more consumption and discourage energy efficiency investments. It was also noted that producers in a competitive market have more incentive to be efficient in transformation, transmission and distribution.

47. Market reform in natural gas and electricity can foster electricity trade and enhance fuel diversity. As noted by a number of Parties, this may have significant potential for emission mitigation. Several also noted that widening of markets may increase domestic emissions as hydrocarbon production increases or more electricity is generated for export. A number of Parties are in the early phases of market restructuring and describe the uncertainty of structural developments in terms of fuel choice, investment and trade patterns, and the implications for CO_2 emissions. For most Parties, other than Belgium, Switzerland and the United States, that estimate effects, policies and measures related to energy transformation account for substantial percentages of CO_2 reductions in 2000. The level of these estimated sectoral reductions does not increase significantly between 2000 and 2010.

48. Pollution regulations, which are generally imposed for local air quality concerns, are highlighted by several Parties as prompting shifts to cleaner fuels (e.g., SWE, USA). Although CO_2 mitigation is not the primary policy objective, these regulations affect the amount and share of fossil fuel consumption in primary energy transformation, which influences CO_2 levels. Specific actions include retrofitting or repowering of facilities to increase thermal efficiency and fuel switching from coal and heavy fuel oil to natural gas. Some Parties allocate part of the revenues derived from the pollution charges to pay for "environment friendly" measures.

49. In addition to regulations, most Parties support research and development on renewable energy. Several subsidize technology development for biofuel use in electricity generation (e.g. FIN, SWE). A number of others focus on accelerated commercialization of technology for alternative energy resources, e.g. wind, fuel cells, geothermal heat pumps. Measures used to influence technology deployment include tax breaks, direct subsidies, and guaranteed markets - either requirements for utilities to obtain a quota of renewable or CHP resources through competitive tendering, or public institution targets to obtain "green" power (e.g., CAN).

2. Industry and residential/commercial/institutional

50. This sector covers emissions from energy end-use in the household, commercial and public sectors as well as from the combustion of fossil fuels and by-products from industrial processes. They are combined here as many Parties report similar GHG mitigation strategies for these subsectors. These sectors accounted for 38 per cent of CO_2 emissions from Annex I Parties in 1990 and 34 per cent in 1995.

51. All Parties note a key reliance on energy efficiency gains in their CO_2 mitigation strategies and the largest number of measures are directed to this end. Most Parties use a variety of policy devices, including economic instruments to tax energy consumption, or provide financial incentives for energy efficiency investments. Education and technical assistance, building code regulations and standards for efficiency-related labelling of products are also among the most common measures.

52. Voluntary approaches figure predominantly in many of the second national communications. They include a variety of public-private partnerships to stimulate energy efficiency gains and emissions reductions through best practices and technology deployment. In the Netherlands, voluntary agreements negotiated with industry set targets for efficiency improvements that are binding in nature. For other Parties, voluntary approaches are used to heighten awareness and to encourage public pledges to take action to mitigate GHG emissions.

53. Few, if any, measures aim to influence the rate of capital stock turnover. Rather, the general approach is to encourage the choice of efficient equipment, appliances and processes when new investments are made. In a similar vein, regulations and standards for buildings generally are applied to new construction and much less frequently to renovations. Therefore, the effects of many of these measures will only be realized with time. Indeed, measures in the

residential/commercial and industrial sectors account for a growing percentage of CO_2 reductions over time for Parties that estimated the effects of measures.

3. Transport

54. All Parties reported measures in the transport sector. The majority of them target CO_2 emissions with consequent effects on N_2O and ozone precursors. The primary approach of most Parties is to:

- Increase the fuel efficiency of vehicles through taxes, regulations and/or voluntary approaches;
- Reduce noxious emissions through regulations;
- Increase options for public transport through economic instruments and planning; and
- Maximize efficiency in transport systems, for example by inducing modal shifts through economic incentives, regulations and voluntary actions.

55. Fuel and vehicle taxes are the main instruments for limiting emissions in reporting European Parties (e.g., FIN, GBR, SWE, NOR). In Norway, according to the communication, gasoline consumption dropped by 8 per cent from 1990 to 1995 partly because of significant CO_2 and general tax rate increases. In the United Kingdom, improved fuel efficiency is projected to be achieved in response to price signals, with road fuel duty increases of at least 5 per cent per year in real terms. For all Parties, fuel taxes tend to have emissions control as a secondary aim with revenue raising as the primary objective.

56. Several Parties (e.g. DEU, FIN, GBR, IRE) noted a planned strategy in the European Union (EU) to reduce CO_2 emissions for new passenger cars by 2005-2010. A voluntary agreement with manufacturers to improve fuel efficiency is the centrepiece of the strategy. Support for proposed EU increases in minimum mineral oil taxes was included in measures listed by some Parties (e.g. AUT, DEU).

57. Support for proposals to eliminate tax exemptions for international aviation fuel was noted by Germany and the United Kingdom.

58. Measures reported by North American Parties aim to curb the growing demand for road vehicle travel and stimulate the market for efficient technologies largely through information and education. Canada also mentioned research and development on alternative transport fuels and vehicle fuel efficiency.

59. A number of Parties (e.g., CHE, GBR, SWE) point out that measures that reduce emissions of some gases may increase them for others. For example, catalytic converters fitted to passenger cars have had beneficial impacts on local air quality by reducing nitrogen oxides, hydrocarbons and methane. On the other hand, their application results in more N_2O emissions. Catalytic converters also may limit the scope of manufacturers to reduce CO_2 emissions because of required air-fuel mix ratios.

60. Across the range of communications, both the measures reported and the monitoring data provided illustrate the difficulties that Parties face in dealing with transport emissions. For instance, while some Parties reported improved average fuel efficiency levels, they also noted large increases in the number of vehicle-kilometres driven and low occupancy levels, which offset gains in fuel efficiency. Many Parties drew attention to the strong link between economic development and transport demand growth. The measures described by most Parties and their projected effects demonstrate that reducing emissions from the transport sector remains a significant challenge.

4. Land-use change and forestry

61. Measures to preserve and increase carbon sinks in forests and woodlands remain the dominant approach in this sector. Most Parties describe afforestation as the main measure. Carbon sequestration tends to be a secondary objective of forestry policy. Parties use a variety of methods to enhance or maintain carbon sinks in forests, including sustainable timber management practices, regulations, subsidies for initial investments, tax incentives, voluntary agreements and promotion.

62. Vegetating denuded land is one of the main climate change-related measures implemented in Iceland. Other reported land-use changes which are expected to increase carbon reservoirs include non-rotational set-aside - part of the reform of the EU Common Agricultural Policy - by which farmers must set aside a percentage of arable land. As noted by the United Kingdom, the impacts of such measures are difficult to assess.

D. Measures targeting methane

63. Methane emissions originate primarily from agriculture, fossil fuel production and distribution, waste management and sewage treatment. Reduction of CH_4 emissions in the *agriculture* sector is largely a side-effect of policies undertaken for financial and economic reasons, for example removal of subsidies in New Zealand and reform of the Common Agricultural Policy in European Union countries. Declining animal numbers reduce ruminant methane emissions. Improved animal productivity and waste management activities are expected to contribute to emissions reductions in a number of Parties (e.g. CZE, NLD, NZL, SLO, USA).

64. Subsidy and sector reform are also anticipated to reduce CH_4 emissions from coal-mining as a by-product of economic policy objectives(e.g. DEU, GBR). Other measures related to *fugitive fuel* emissions concentrate on reducing leaks in natural gas distribution and storage systems (e.g. CAN, GBR, IRE, NLD), largely through voluntary means.

65. The largest CH_4 emission reductions are expected to emanate from waste management activities: reduction of waste disposal in landfills through recycling and waste incineration. In addition, significant CH_4 emission mitigation is expected from measures to recover gas from landfills and sewage treatment facilities, often for energy purposes. Generally these measures have

been adopted in response to primary concerns of waste disposal, e.g. aesthetic, health and safety concerns.

66. Regulations govern waste disposal practices in most reporting Parties. In some, they compel or encourage recycling, separation and composting. Several, including the United Kingdom, have introduced taxes or landfill fees to reflect environmental costs. Diversion of waste from landfills to waste-to-energy plants is usually pursued through voluntary means or economic incentives, though a Swiss regulation requires incineration of all combustible waste.

67. Methane emissions decreased in the 1991 to 1994/95 period in most reporting Parties, except Canada and Norway where emission increases were likely related to robust oil and natural gas production, and the United States of America where the increase was related to growth in emissions from agriculture and waste disposal. Data indicate that the relative share of the various CH_4 sources was unchanged for the group of reporting Parties between 1990 and 1994. Most of the Parties, except Canada and Ireland, project reduced CH_4 emissions in 2000 compared with 1990 levels.

E. Measures targeting nitrous oxide

68. Anthropogenic emissions of nitrous oxides originate from *agriculture*, particularly the use of chemical fertilizers, fuel combustion in *energy transformation* and *transport*, and industrial processing. *Agriculture* is the largest source of N_2O emissions for the majority of reporting Parties, but emissions from *transport* have been the fastest growing in many of them.

69. Some Parties did not report specific policies and measures targeting N_2O. Many noted that measures to mitigate CO_2 or CH_4 emissions in energy and agriculture would also reduce N_2O emissions. Conversely, several Parties pointed out that while catalytic converters substantially reduce several key air pollutants, they emit N_2O as a side-effect.

70. Measures generally fall into two categories: improved efficiency of nitrogen fertilizer use and modification of manufacturing processes for nitric acid (used in fertilizer production) and adipic acid (an intermediate in the production of nylon). Measures employed include: voluntary agreements with industry; regulations requiring best available technology not entailing excessive costs; research and demonstration for agricultural management; and subsidy reform in the agricultural sector.

71. Although only five Parties provided estimates of effects, the specific N_2O measures are expected to achieve most of the emission reductions by 2000 and thereafter the emissions will remain at a relatively low level. In three Parties, the reductions are expected to result from a measure to limit N_2O emissions from adipic acid manufacturing. This is to be accomplished on a voluntary basis in Canada and Germany and via regulation in the United Kingdom. Slovakia and the United States project N_2O emission reductions in 2000 and beyond from measures to boost the efficiency of nitrogen fertilizer use.

F. Measures targeting HFCs, PFCs and SF_6

72. In line with the revised guidelines, the majority of Parties have extended their inventories to include hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride and mention them in the policies and measures text in second national communications. Several Parties emphasize that emissions of these gases are currently low, but they are significant both in terms of their very high global warming potentials and the likely growth of emissions in the near future. In particular, emissions of HFCs are anticipated to increase by 2000 as they are used as a substitute for ozone-depleting gases controlled under the Montreal Protocol. This trend was highlighted by many Parties (e.g., GBR, ICE, NLD, NOR, USA).

73. Strategies to control HFCs, PFCs and SF_6 are not well developed yet in the majority of reporting Parties. One Party (USA), however, reported a national strategy to minimize future emissions of HFCs and PFCs. It features voluntary approaches with HFC-23 and primary aluminium producers to develop and implement favourable processing practices or technology and regulatory mechanisms to limit the use of HFCs and PFCs where alternatives are available. This strategy is projected to make a significant contribution to the United States total GHG emission reductions in the 2000 to 2020 period.

74. Several Parties also acknowledged efforts to develop voluntary arrangements with aluminium producers to reduce PFC emissions (e.g. DEU, ICE, NOR) and with electrical equipment manufacturers concerning SF_6 emissions (DEU, GBR). Air quality and integrated pollution control laws regulate PFC emissions in New Zealand and the United Kingdom. PFC regulations are being considered in Iceland. The Netherlands has technical requirements for refrigeration equipment to limit HFC leakage. Switzerland reports restrictions on the use of HFCs and PFCs as aerosol propellants and extinguishing agents in fire protection equipment.

IV. PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

A. Presentation of results

75. Numerical data on the projection for 2000 and up to 2020 are given in tables C.1 to C.8 in document FCCC/SBI/1997/19/Add.1. The tables present for each Party the projected emissions and removals of GHGs, as well as information on the 1990 levels used as the basis for the projections, the 1990 (base year) inventory figures, and the latest reported inventory figures, generally for 1995. The decrease or increase in projected emissions compared to the base year figures is presented as a percentage. For the *land-use change and forestry* sector, negative values in mass units denote removals by sinks and negative values in percentage denote more removal or decrease in net emissions in the projected year compared to 1990.

76. Tables provide projection information on a gas-by-gas basis. The projections of CO_2 emissions from bunkers are presented separately. To present the projected emissions of HFCs, PFCs and SF_6 in a comparable way the secretariat prepared GWP-based tables for each of these

gases. To summarize the projections of emissions for all gases provided by individual Parties a similar GWP-based approach was used for presenting tables with and without the *land-use change and forestry* sector, recognizing the concerns expressed by some Parties regarding the procedure of adding emissions and removals from this sector to emissions from other sectors. The footnotes and notes should be treated as an integral part of the tables. The projections provided by Parties are not comparable and, in accordance with decision 2/CP.1 (FCCC/CP/1995/7/Add.1), individual national totals were not added.

77. In some cases there are differences in the 1990 emission figures between inventories and projections. These differences are due to rounding, calibration of models, updating of inventories subsequent to the projections being developed, and the fact that some Parties did not include exactly the same sources in the projections as in the inventories. In three cases (CHE, NLD, SWE), such differences also reflect the use of adjustments.

B. Approaches used and methodological issues

78. All Parties provided "with measures" projections for CO_2 emissions. Ten Parties provided more than one scenario, among them the "without measures" projections requested by the FCCC guidelines. Several Parties provided up to five scenarios, some of them subdivided into different trends. In some cases, such as Belgium, the Netherlands and Switzerland, one of these scenarios corresponded to "implemented measures" and the other, with more substantial emission reductions, to measures "under consideration". Some Parties stated that some of these measures would only be possible in the context of international or regional common policies. For five out of the six Parties (CAN, GBR, ICE, IRE, NOR, SWE) which reported only one scenario, it was difficult to deduce the effects of the reported measures; the United Kingdom, however, explained these effects in a clear quantitative manner. All reporting Parties provided only one scenario for all the other greenhouse gases, with the exception of the Netherlands and Slovakia, which provided more than one scenario for CH_4 and N_2O projections.

79. Parties used different approaches to estimate their projected emissions, reflecting variations in economic structure, experience and data availability. Generally the models were well described. Macroeconomic "top-down" models played a dominant role for energy CO_2 projections, but equilibrium "bottom-up" models were also used. Some Parties (BEL, CAN, SLO, USA) combined different types of models (econometric, macroeconomic, "engineering", etc.) to take advantage of their respective strengths. Some Parties either did not mention which models were used (e.g. GBR) or provided only a brief explanation (e.g. IRE).

80. Reporting on assumptions improved substantially compared with the first national communications. The revised FCCC guidelines contributed to this improvent in reporting, although some Parties did not use the suggested tables to present key information in a structured way. Assumptions related to gross domestic product (GDP) growth, demographic growth, energy prices, structural changes in energy demand and supply, and policy choices differed considerably among Parties, reflecting the different national circumstances, and the time span of the projections. Economic growth was considered to be a driving force for several

Parties, but in some of them (e.g. CHE, NOR, SWE) structural changes in energy supply were expected to play a very important role.

81. The assumptions used in the projections of the two reporting Parties with economies in transition differ from those for Annex II Parties owing to radical changes in their economic systems. As stressed in Slovakia's second national communication, a simple extrapolation of historical data on energy consumption is not sufficient to model future emission projections. In addition, both the Czech Republic and Slovakia assume substantial changes in industrial production and anticipate shifts from (heavy) industry to the service sector.

82. In general, the description of the assumptions and approaches used to project the emissions of other GHGs has also improved. Nevertheless, they were less well documented than the CO_2 emissions projections, reflecting a higher degree of uncertainty in with measuring emissions from non-energy sources and the smaller contribution of these gases to the total GHG emissions.

83. With a few exceptions (NZL, SLO, USA), the projections of CO_2 emissions or removals in the *land-use change and forestry* sector were not well described. For all reporting Parties the projections of CO_2 removals in this category were mostly linked to forestry activities. However, the United Kingdom projected in addition CO_2 emissions from other land-use change activities, which offset its forestry removals. The methods of estimating CO_2 removals varied substantially among Parties, but this methodological problem is more related to the GHG emission inventories rather than to their projections, which are based on the future application of these methods.

84. Projections of HFCs, PFCs and SF_6 emissions were requested on a mandatory basis for the first time. Reported projections for these gases have the same deficiency as their inventories. It was not clear (with a few exceptions) whether the projections were based on actual or potential emissions. In many cases the figures for the classes of substances were not further disaggregated into gas species, which is important because of the significant differences in their GWPs. Further development of the reporting guidelines could improve the quality of these projections.

85. Four Parties (BEL, CHE, NLD, SWE) adjusted upwards their 1990 CO_2 emissions figures used for projections to account for climatic anomalies in the base year, and also with the aim of evaluating how policies and measures affect emissions irrespective of the climatic fluctuations. Belgium also presented an unadjusted figure. The differences between their 1990 inventory data and the adjusted figures used for projections ranged between less than 1 per cent for Sweden and 3.9 per cent for the Netherlands. All these Parties provided transparent information on the approaches used.

86. No Party adjusted its figures for electricity trade, but some mentioned the importance of this factor in the projections of energy-related CO_2 emissions. Switzerland stated that the projections are made on the assumption that the present domestic nuclear power capacity remains in existence, and electricity purchasing agreements with France are renewed. Sweden noted that one of the alternatives to building new power plant in Sweden, which is entailed by the planned

closing-down of one nuclear reactor before 2000, could be to import electricity from the Nordic electricity market.

87. Reporting on the uncertainty of the projections did not improve significantly. Although this issue was mentioned by all reporting Parties, in most cases the discussion was brief. Only Canada and Slovakia estimated how the results would be affected by changes in key assumptions. Canada also presented detailed information on how the assumptions, expert assessment and sectoral models feed into the evaluation of the main model for the estimation of emissions. Iceland presented the uncertainty related to all GHG projections in a sectoral table which attributes to each entry a cardinal level of confidence.

C. Projections for 2000-2020 and overall effects of measures

88. All reporting Parties except France[3] provided projections for the emissions of the main GHGs for 2000. Belgium provided them up to 2005 and the Czech Republic, Slovakia and Switzerland up to 2010. Ten Parties gave in addition projections for 2020 and 13 Parties provided sectoral projections only partially. Ten Parties presented detailed projections for PFC, HFC and SF_6 emissions. Twelve Parties provided projections on the *land-use change and forestry* sector.

89. All Parties presented new figures for projected emissions in 2000 differing from those given in their first national communications. Eleven Parties revised their projected CO_2 emissions downwards, while the remaining five reporting Parties (BEL, ICE, NOR, NZL, USA) revised them upwards. Projections for CH_4 and N_2O emissions were also changed in almost all cases. This is explained by changes in the assumptions used in the previous projections or modifications in the methods. In general, these changes are well documented in the second national communications.

90. A comparison of projections for 2000 presented in the second national communications with inventories for the base year and the latest reported year, suggests that for the majority of the reporting Parties additional measures would be needed to return CO_2 emissions to their 1990 level by 2000. This return is more likely for CH_4 and N_2O emissions, which are projected to decrease in most of the reporting Parties. The emissions of other GHGs are expected to grow significantly. Long-term projections presented by Parties indicate that similar trends in GHG emissions a expected beyond 2000 up to 2020. The increase in combined GHG emissions expressed in CO_2 equivalent is projected to be even larger than for 2000 for most of the reporting Parties.

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[3]The preliminary version of the second national communication of France received by the secretariat did not contain information on projections.

91. Ten Parties (BEL, CAN, FIN, ICE, IRE, NLD, NOR, NZL, SWE, USA) accounting for 44 per cent of the 1990 CO_2 emissions from Annex I Parties, projected an increase in these emissions to 2000. Seven Parties (AUT, CHE, CZE, DEU, GBR, NLD, SLO) projected stabilization or a decrease in CO_2 emissions for 2000 compared to the base year levels. Their contribution to the 1990 CO_2 emissions from Annex I Parties amounted to 15 per cent. The long-term projections up to 2020 presented by ten Parties indicated that almost all of them expect a further growth in their CO_2 emissions above the 2000 level. Only Finland (in one of the presented scenarios) and Germany projected decreases in the longer term.

92. Thirteen Parties (CAN, CHE, CZE, DEU, FIN, GBR, ICE, IRE, NLD, NOR, NZL, SLO and SWE) presented sectoral projections for the three main GHGs on the basis of the tables requested by the FCCC guidelines. The United States presented them for CO_2 fuel combustion emissions. Two Parties (FIN, NLD) did not disaggregate their CO_2 emissions, but the other twelve Parties projected an increase in their CO_2 transport emissions for 2000 and up to 2020, confirming the trend in emissions from this sector for 1990-1995. All Parties also projected an increase in their N_2O transport emissions. In the longer term, CO_2 emissions from the energy and transformation sector are projected to grow for 12 Parties. The Czech Republic, Germany, Slovakia and the United Kingdom projected a stabilization or decrease.

93. Sixteen Parties provided CH_4 projections for 2000. Thirteen of them (excepting AUT, CAN, IRE) accounting for 45 per cent of the aggregated Annex I inventory figures for 1990, projected stabilization or decreases in CH_4 emissions compared to their base years. All reporting Parties (except AUT and FRA) provided N_2O projections for 2000. Eight of these Parties, accounting for 43 per cent of the 1990 aggregated inventory figures for Annex I Parties, projected stabilization or decrease in N_2O emissions compared to their base years. Long-term projections for both CH_4 and N_2O have trends similar to those for 2000.

94. Ireland, New Zealand and Slovakia projected an increase in CH_4 emissions in the form of *fugitive fuel* emissions, Canada, Ireland, Norway and Sweden increases from *enteric fermentation* and Canada, the Czech Republic and Slovakia from *waste*. All the other Parties projected a decrease in CH_4 emissions for those sectors. N_2O emissions, with the exception of those from *transport* and other energy sectors, were projected to have a similar decreasing trend. Only two Parties (NLD, SWE) projected an increase in their emissions from *industrial processes* and only four (CAN, NOR, SLO, SWE) in emissions from *agricultural soils*.

95. Most of the reporting Parties provided projections for HFCs, PFCs and SF_6. For 2000 Parties that made projections for HFCs expect a considerable growth, while PFC projections show a decreasing trend. SF_6 emissions are projected to grow for all but two (CAN, NOR) reporting Parties. For 2020, emissions of all these gases are projected to increase and their importance relative to other gases is expected to grow.

96. Long-term projections for HFCs and PFCs were provided by nine Parties and for SF_6 by eight. The United States presented projections in CO_2 equivalent for all these gases combined. All these Parties expected a considerable growth in the emission of these gases as a consequence

of the phase-out of CFCs, and the scheduled phase-out of hydrochlorfluorocarbons (HCFCs) under the Montreal Protocol, since HFCs are used as substitutes for these substances. Sharp projected increases in HFC emissions are also explained by the fact that this transition took place mainly after 1992 and the levels of these emissions in the base year were very low. PFC projections revealed a different pattern. Five (DEU, GBR, ICE, NOR, NZL) out of nine Parties that provided information on PFCs projected a decrease for 2000 as a result of reductions in emissions from the aluminium industry. Two Parties (CAN, NOR) projected a decrease in SF_6 emissions for 2000, mainly as a consequence of improved production practices in the magnesium industry, while the other seven projected an increase.

97. When all projected emissions (excluding *land-use change and forestry*) are totalled using IPCC 1995 GWPs, nine of the reporting Parties (BEL, CAN, FIN, ICE, IRE, NOR, NZL, SWE, USA) projected an increase for 2000. Six Parties (CHE, CZE, DEU, GBR, NLD, SLO) projected a decrease. Projections to 2020 revealed a different pattern: only two Parties (DEU, FIN) projected a decrease, while the other eight Parties projected an increase, five of them (CAN, ICE, NZL, SWE, USA) projecting an increase of more than 25 per cent.

98. Thirteen Parties reported projections in the *land-use change and forestry* sector. For twelve Parties this sector was projected to remain a net sink in 2000. For nine Parties net CO_2 removals in 2000 were projected to increase; among them was the United Kingdom, for which the removal by forests is offset by other emissions in the *land-use change and forestry* category. Belgium and Switzerland projected removals to remain stable up to 2020 and Sweden indicated that their removals could be decreasing up to 2000 and afterwards. In the long term (2020), the Netherlands, New Zealand, Norway, Slovakia and the United States projected an increase in removals by forests. Finland presented a range with decreases for 2000 and both increases and decreases for 2020 described as plausible options.

D. Estimated mitigation effect of individual measures

99. It appears that estimation of mitigation impacts was one of the most problematic components in the national communications and hence in filling in the relevant summary tables requested in the FCCC guidelines. Some Parties included quantitative estimates of mitigation impact for all measures for 2000, 2005, 2010 and 2020. Others reported for a subset of those years and/or provided estimates for selected measures. Most of the communications mentioned the difficulty of estimating the effects of measures, highlighting that estimates on an individual measure basis do not reflect the interaction and synergy of a portfolio of measures and the uncertainties related to projections in the long-term, e.g. assumptions of economic and population growth. The extent to which the guidelines were followed is illustrated in tables 5 and 6.

100. An estimate of the effect of policies and measures on carbon dioxide emissions was provided by 13 of 17 reporting Parties (AUT, BEL, CAN, CHE, CZE, DEU, FIN, GBR, NLD, NZL, SLO, SWE, USA). Seven Parties (CAN, DEU, GBR, ICE, NOR, SLO, USA) provided an estimate of the effect of policies and measures on CH_4 emissions, and estimates of the effects of policies and measures on N_2O emissions were provided by five Parties (CAN, DEU, GBR, SLO, USA). Parties that provided estimates of the effects of policies and measures on GHG emissions usually provided them through at least 2010, and many of these Parties also provided estimates for 2020.

101. The data in table 5 also show that the effectiveness of policies and measures directed at CO_2 emissions will increase significantly with time. A similar trend is evident with respect to CH_4 emissions. Policies and measures targeted at N_2O emissions, however, are expected to achieve virtually all of their emission reductions by 2000.

102. The effects of policies and measures on other GHG emissions were reported by three Parties (DEU, GBR, USA). Germany provided an estimate of the effects of policies and measures on non-methane volatile organic compound (NMVOC) emissions in 2005 and 2020. The United Kingdom provided estimates of PFC and HFC emission reductions in 2000, 2005, 2010 and 2020. A combined estimate (in carbon equivalents) of reductions in emissions of PFCs, HFCs and SF6 was provided by the United States for 2000, 2010, and 2020.

103. Estimates of the effects of measures to enhance CO_2 removals by sinks were provided by five Parties (ICE, IRE, NZL, SLO, USA). These are not presented in the table since different methodologies used to estimate removals did not allow meaningful comparisons.

Table 5. Estimated reductions in CO_2, CH_4 and N_2O emissions in 2000, 2005, 2010 and 2020 as a result of implementation of policies and measures (Gigagrams)

	CO_2				CH_4				N_2O			
	2000	2005	2010	2020	2000	2005	2010	2020	2000	2005	2010	2020
AUT	6 200	7 500	8 200									
BEL	4 100											
CAN	18 600		39 100	78 100	437	618	698	795	33.8	33.8	34	33.8
CHE	1 700		4 700	5 600								
CZE	5 000											
DEU	66 500	116 500	171 000	283 000	845	1 486	1 661	1 856	88	89	90	90
(DEU)		(85 400)										
FIN	6 000		7 000									
(FIN)	(6 000)		(15 000)									
FRA												
GBR	129 200	146 800	183 500	179 800	937	1 274	1 586	1 956	57	58	58	58
ICE					1.5							
IRE												
MON												
NLD	23 500	29 000	34 000	49 000								
NZL	1 500		3 300	5 900								
NOR					27	32	72	72				
(NOR)					-32	92	-132	-132				
SLO	2 200	3 700	4 400		78.7	111.6	142.8		3.8	4.8	4.6	
SWE	17 500	21 500	23 700									
USA	116 000		348 300	530 700	2 708		4 089	4 229	62.7		63	62.7

Austria: the effects of policies and measures on CO_2 emissions are the difference between a "current measures" projection and a "without measures" projection. The "current measures" projection assumes that no additional measures will be taken in the future but currently implemented measures will continue to be effective. It is indicated, however, that the "current measures" projection assumes that none of the measures in chapter 5 of the second national communication have been implemented, although chapter 5 indicates that some of these are currently in place. Two "additional measures" projections that demonstrate greater emission reductions are also presented, but it is not clear what measures have been included in these scenarios or the extent to which they have been implemented. Accordingly, they are not been presented here.

Belgium: the effects of policies and measures on CO_2 emissions are the difference between a "without measures" projection and a "with measures projection". A "without measures" projection is only provided for the year 2000, and that is therefore the only year presented here. The "with measures" projection includes non-fiscal measures that are in the process of implementation or have already been implemented, as well as fiscal measures undertaken between 1990

and 1994 that have had an impact on CO_2 emissions. These measures are clearly identified. Belgium also provides an "envisaged measures" scenario and a "long-term measures" scenario that produce greater emission reductions, but they are not presented here.

Canada: the effects of policies and measures on emissions are the difference between a "without measures" projection and a "with measures projection".

Czech Republic: the Czech Republic provides various projections in its national communication. Since they differ in assumptions about GDP growth, economic restructuring, and the implementation of policies and measures, it was possible to evaluate the effect of policies and measures from this information alone. Accordingly, an estimate of the effects of policies and measures on CO_2 emissions in the year 2000 has been derived from an estimate provided of the effects of four measures that are already in place.

Finland: Finland provided an estimate of the impact of implemented policies and measures on CO_2 emissions as a range for the year 2010 (the upper range being presented in parentheses in the table). This range reflects uncertainties about the ultimate impact of action to liberalize electricity markets and investments in research, development and demonstration for new technologies. The effects of policies and measures in the year 2010 appear to reflect a CO_2 tax that is assumed to be applied internationally from the year 2000.

France: the preliminary second national communication did not contain estimates of the effects of policies and measures.

Germany: estimates of the effects of policies and measures on CO_2 emissions are presented on the basis of two different studies. In each case, the estimate is the difference between a "without measures" scenario (numbers in parentheses) and a "with measures" or "IMA-measures" scenario that takes agreed climate protection measures into account wherever possible. The second study only considers energy-related carbon dioxide emissions. Estimates of the effects of policies and measures on CH_4 and N_2O emissions are the difference between "with measures" and "without measures" projections.

Iceland: Iceland did not provide an estimate of the overall effect of policies and measures on future greenhouse gas emission levels. The number presented in the table is the effect of one measure taken to reduce CH_4 emissions from landfills.

Ireland: Ireland presented the effects of a number of individual measures on CO_2 emissions in a non-integrated manner. The dates vary for different measures and some effects are presented cumulatively while others are presented on a per annum basis. Accordingly, it was not possible to include these data in the table.

Monaco: Monaco did not estimate the effect of policies and measures in its second national communication.

Netherlands: the estimate of the effects of policies and measures on CO_2 emissions is the difference between the "trend" scenario and the "without measures" scenario. The "trend" scenario does not include the effects of the most recent additions to existing policy in the Third White Paper on Energy Policy (December 1995) and the CO_2 Reduction Plan (September 1996). A "favourable" scenario has also been presented that includes some estimates of these more recent policies, but it is not presented here because it also includes a number of EU initiatives (such as an energy tax) that have not yet been agreed to.

New Zealand: the estimates of the effects of policies and measures on CO_2 emissions are the difference between a "with measures" scenario and a "business as usual" scenario. The "with measures" scenario captures some of the effects of energy market reforms, implemented greenhouse gas mitigation policies, and changes in consumer behaviour. It is noted that not all changes in consumer behaviour and technology development may be the product of policy. Accordingly, the national communication states that these estimates should be treated with caution. Three different GDP growth scenarios are provided and these data are taken from the medium growth scenario. "With measures" projections

are provided for other energy-related greenhouse gases, but the effects of policies and measures are not explicitly identified.

Norway: Norway did not provide a comprehensive estimate of the effects of policies and measures in its national communication. It did, however, provide a low and high estimate (in parentheses) of the effects of its policies and measures on CH_4 emissions from landfills. These estimates are the difference between an "already implemented measures" scenario and a scenario that includes the effects of new policies and measures. A range of estimates is provided and these are included in the table.

Slovakia: estimates of the effects of policies and measures on CO_2 emissions are the difference between scenarios 1 and 3 in the national communication. Scenario 1 is a baseline scenario, and scenario 3 includes current and proposed legislation. The same is true for CH_4 and N_2O emissions, although in these cases scenario 3 often represents the medium figure of a range of possible impacts associated with the implementation of current and proposed policies and measures.

Sweden: estimates of the effect of policies and measures on CO_2 emissions were calculated from the difference between the "with measures" scenario and a reference scenario that was constructed by taking out key policies and measures included in the "with measures" scenario. It is noted in the national communication that this calculation contains a large measure of uncertainty and must be interpreted with great caution because it compares two projections that are both uncertain.

Switzerland: estimates were based on bottom-up energy forecasts models and draw a distinction between implemented measures and measures under consideration. The estimate presented is based on the assumption that the present structure of electricity supply will not change significantly in the near future.

United Kingdom: the estimates of the effects of policies and measures on CO_2, CH_4, and N_2O emissions were clearly presented in the national communication. They appear to be based on policies and measures that have been adopted and implemented. It is noted that the estimates are subject to increasing uncertainty as one moves further into the future.

United States: the estimates of the effects of policies and measures on CO_2, CH_4, and N_2O emissions were clearly presented in the national communication and appear to be based on policies and measures that have been adopted and implemented. There is a good discussion of why these estimates differ from estimates made in the first national communication.

104. While table 5 shows the absolute emission reductions a Party expects to achieve as a result of its policies and measures, table 6 illustrates the impact of emission reductions relative to a Party's base year emission levels for CO_2, CH_4, and N_2O. This provides an indication of the relative impact different climate change action plans are having on absolute emission levels. The percentage figure included in table 6 indicates the extent to which policies and measures are expected to reduce emissions below 1990 levels in 2000, other things being equal. Of course, other things do change (e.g., population, GDP) and these changes sometimes tend to offset the CO_2 emission reductions generated by policies and measures, as discussed in section IV. (c). As table 6 illustrates, although the estimates provided by most Parties (except GBR, NLD and SWE) for the effect of individual policies and measures would lead to the conclusion that CO_2 emissions in 2000 will be up to 11 per cent lower than in 1990, in actual fact this trend is often projected to be offset by the growth in CO_2 emissions from some sources. There is, however, a wide range in the relative impacts of policies and measures in different Parties.

Table 6. Impact of emission reductions in 2000 relative to 1990

	Expected reduction in emissions in 2000 as a result of policies and measures (Gg)			1990 emissions (Gg)			Percentage reduction in 2000 relative to 1990		
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
AUT	6 200			59 200			11		
BEL	4 100			113 400			4		
CAN	18 600	437	33.8	464 000	3 200	86	4	14	39
CHE	1 700			45 100			4		
CZE	5 000			165 500			3		
DEU	66 500	845	88	1 014 200	5 682	226	7	15	39
FIN	6 000			53 800			11		
GBR	129 200	937	57	580 200	4 402	113	22	21	51
ICE		1.5			23			7	
NLD	23 500			167 600			14		
NOR*		27			432			6	
NZL	1 500			25 500			6		
SLO	2 200	79	3.8	60 000	409	10.7	4	19	36
SWE	17 500			55 500			32		
USA	116 000	2 708	62.7	4 957 000	27 000	411	2	10	15

* Low growth scenario

105. Most reporting Parties indicated that the effectiveness of policies and measures directed at CO_2 emissions will increase significantly with time. A similar trend is evident with respect to CH_4 emissions. Policies and measures targeted at N_2O emissions, however, are expected to achieve virtually all of their emission reductions by 2000. Most reporting Parties expect their policies and measures to reduce CH_4 emissions by an amount equivalent to 10-20 per cent of 1990 levels, while the coresponding target for N_2O policies and measures is usually a reduction of more than 30 per cent. These relatively higher emission reductions explain the fact that emissions of these gases are projected to fall or increase only marginally in 2000.

106. In addition to reporting the estimated effects of policies and measures by gas, the reporting guidelines request Parties to provide this information by sector. Of the 12 Parties that provided an aggregate estimate for CO_2 emission reductions resulting from policies and measures, nine Parties (BEL, CAN, CHE, DEU, FIN, GBR, SLO, SWE, USA) disaggregated these data by sector. Virtually all of the Parties that reported on the estimated effects of policies and measures on CH_4 emissions did so on a sectoral basis. The same was true with respect to Parties reporting on the estimated effects of policies and measures on N_2O emissions, but for several Parties emission reductions came from only one sector. A breakdown of CO_2 emission reductions by sector is presented in table 7.

107. The contribution made by different sectors to CO_2 emission reductions varies significantly from country to country. In three Parties (FIN, GBR, SLO), the majority of emission reductions

occur in the energy and transformation industries. In five other Parties (BEL, CAN, DEU, SWE, USA), the majority of emission reductions are produced through energy efficiency improvements in the residential, commercial, institutional and industrial sectors. In one Party (CHE), virtually all emission reductions occur in the transport sector. The relative contributions of different sectors to CO_2 emission reductions changes very little in most countries with time.

108. Four Parties (CAN, GBR, SLO, SWE) disaggregated to at least some extent the total effects of their policies and measures on CO_2 emissions by policy instrument, even though this is not required under the reporting guidelines. It was not however possible to draw conclusions from these data, since Parties often found it difficult to separate the impact of regulatory and voluntary programmes directed at energy efficiency improvements. Indeed, the only policy instrument for which the effects could be identified on a consistent basis was taxation. Increased taxes are projected to be responsible for 95 per cent of the CO_2 emission reductions produced by policies and measures in Sweden in 2000, but they only account for 10 per cent of the CO_2 emission reductions produced by policies and measures in the United Kingdom.

109. The reporting guidelines also state that, wherever possible, Parties should report on the effects of individual policies and measures on GHG emissions. Most Parties provided an estimate of the effect of at least a few individual policies and measures on GHG emissions. Only six Parties (CAN, FIN, GBR, SLO, SWE, USA), however, tried to break down their estimates of the expected effects by measure or by group of measures.

110. In all reporting Parties, the majority of GHG emission reductions, calculated on a CO_2 equivalent basis, come from the effect of policies and measures on CO_2 emissions. In two Parties (CAN, DEU), the second most important contribution in the year 2000 is made by reductions in emissions of N_2O, but CH_4 emission reductions are the second most important contributor (as they are in Slovakia and the United Kingdom) in subsequent years. The United States is unique in that emissions in reductions of other gases (PFCs, HFC, and SF_6) make the second most important contribution to GHG emission reductions throughout the period.

Table 7. Sectoral breakdown of the estimated effects of measures to reduce CO_2 emissions in 2000, 2005, 2010 and 2020 (percentage)

	Energy and transformation industries				Residential, commercial, institutional				Industry				Transport			
	2000	2005	2010	2020	2000	2005	2010	2020	2000	2005	2010	2020	2000	2005	2010	2020
BEL[a]	2				49				10				39			
CAN[b]	35		30	19	53		56	69	53		56	69	10		12	12
CHE[c]			2		18		8	11			6	5	82		83	84
FIN	67		71		33		29		33		29		33		29	
(FIN)			-67				-33				-33				-33	
DEU[d]	36	38			42	38			8	13			12	10		
SLO	83	63	56		6	9	9		2	1	1		9	28	34	
SWE[e]	39	35	42		42	48	42						20	17	16	
GBR	72	63	66	61	19	25	22	24	19	25	22	24	8	13	12	14
USA[f]	6		8	14	50		62	59	23		13	13	26		18	17

[a] The effects of measures in agriculture and tertiary sectors have been included under the heading residential/commercial/institutional.

[b] Canada has not calculated expected emission reductions in energy end-use sectors for the year 2005 and therefore no data are presented for that year.

[c] Emission reductions from the transportat sector include reductions in emissions associated with the use of international bunker fuels.

[d] Figures calculated by the secretariat on the basis of data contained in the "policy scenarios for climate protection" presented in the second national communication.

[e] The figures do not include the effect of "foundation measures" that cut across several sectors. This presents a problem for the year 2000, since these measures account for 34 per cent of total expected CO_2 emission reductions in that year. In subsequent years, the contribution of these measures to expected emission reductions falls sharply (2010 - 10 per cent, 2020 - 8 per cent).

Table 8. Contributions of reductions in emissions of individual gases to total GHG emissions reduction, 2000, 2005, 2010 and 2020* (percentage)

	2000				2005				2010				2020			
	CO_2	CH_4	N_2O	Other	CO_2	CH_4	N_2O	Other	CO_2	CH_4	N_2O	Other	CO_2	CH_4	N_2O	Other
CAN[b]	49	24	27						61	23	16		74	16	10	
DEU	60	16	24		66	18	16									
GBR[b]	78	12	11		77	14	9		78	14	8		75	17	8	
SLO	43	33	24		49	31	20		49	34	16					
USA	43	21	7	27					58	14	3	25	65	11	2	22

* The GWPs used were : $CH_4 = 21$, $N_2O = 310$.

[a] Canada has not calculated emission reductions from energy end-use sectors for 2005.

[b] The United Kingdom did provide an estimate of the effects of actions to reduce PFC and HFC emissions, but without disaggregation.

111. The relative contributions of policies and measures targeting individual gases to the overall reduction of emissions are presented in table 8. As indicated in this table, the reduction of CO_2 emission accounts for the largest percentage over time. It is, however, less than the 80 per cent proportion of CO_2 emissions in 1990 for reporting Parties. The relative contribution of CO_2 policies and measures to emissions mitigation increases over time, except in the United Kingdom's estimate owing to significant shifts to lower-carbon fuels prior to 2000. For the other Parties, the increasing CO_2 share reflects taxation and energy efficiency measures. The impact of these measures is evidenced primarily over time as equipment, buildings and other capital stock is turned over. For example, industry is often only able to respond gradually to tax signals due to large sunk capital costs. N_2O emissions reduction, on the other hand, assumes less importance over the period. This reflects the single event nature of measures to reduce N_2O emissions from adipic acid production before 2000.

112. In all reporting Parties the contribution made by CO_2 emission reductions to overall greenhouse gas emission reductions stays constant or increases over time. The contribution made by N_2O emission reductions to overall emission reductions declines in all Parties throughout the period. CH_4 emission reductions play a different role in different countries, increasing in importance in some (DEU, GBR, SLO) and declining in importance in others (CAN, USA).

Annex

METHODOLOGICAL ISSUES RELATED TO INVENTORIES

A. Introduction

1. In general, Parties presented their inventory data in accordance with the IPCC guidelines. All Parties used the 1995 IPCC guidelines format and presented emission estimates on a gas-by-gas basis for the three main GHGs, CO_2, CH_4 and N_2O for 1990 to 1995[1], with the exception of Monaco which indicated that emissions other than CO_2 were considered negligible. A few Parties (DEU, GBR, MON) also provided preliminary estimates of CO_2 emissions for 1996. Estimates of CO_2 emissions and removals for *land-use change and forestry* were provided by 15 Parties. 15 Parties provided estimates for HFCs, PFCs and SF_6, although some of them not for all these gases. All Parties, except Canada and Monaco, provided estimates for the ozone precursors, carbon monoxide (CO), nitrogen oxides (NO_X) and NMVOC, although in varying degrees of detail. Emission estimates of SO_2, reporting of which is encouraged by the FCCC guidelines, were included in the national communications of 12 Parties. In conformity with the guidelines, 14 Parties presented separate data on emissions from *international bunkers* but only six of them provided a breakdown into marine and aviation bunkers. Canada provided only aggregate (CO_2, CH_4 and N_2O) emissions from *international bunkers* in CO_2 equivalent, and seven Parties provided CO_2 emissions only.

2. All reporting Parties provided greenhouse gas inventory information for the years 1990 to 1995, but Finland did not provide its 1991 inventory. All Parties which submitted new inventory data in their second national communications had recalculated their inventories for the base year and subsequent years. The differences with respect to the previously submitted inventories are in some cases significant.

B. Transparency and comparability

3. In order to ensure transparency, Parties were requested to provide enough information to allow the reconstruction of inventories from national activity data, emission factors and other assumptions. Table I indicates how the reporting guidelines were followed in the energy sector. All reporting Parties except Austria provided the IPCC standard data tables, although Ireland presented such tables for 1993 only. The IPCC standard data tables contain sufficient information to reconstruct inventories for some source/sink categories but not, for example, for *energy*, which accounts for the bulk of GHG emissions of Annex I Parties.

4. Parties using a top-down approach to estimate CO_2 emissions from *fuel combustion* need to explain the methodologies used in calculating the apparent consumption of fuel by submitting the

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[1]For the purposes of presenting trends in emissions, data for 1994 were used where data for 1995 were not available.

corresponding IPCC worksheets 1.1 or equivalent documentation. This was done by the Czech Republic, Finland, Germany, Slovakia, the United Kingdom and the United States. The IPCC reference methodology was followed solely by the Czech Republic and Slovakia, while other Parties used CORINAIR[2] or their own methods or a mix of them with those of the IPCC.

5. Austria, Belgium[3], France, Ireland and Switzerland used CORINAIR to compile their GHG inventories and reported them in the IPCC format. The quality of the CORINAIR to IPCC conversion seems better in the second national communications than in the first ones, which reflects the progress achieved in the harmonization of these two methodologies. However, none of the Parties provided sufficient equivalent information covering both the activity data and disaggregated emission factors and correspondence between the IPCC and CORINAIR or other source categories. France provided the information on correspondence only, and Belgium and Switzerland did so partially. The United Kingdom presented detailed information on that correspondence for its own national methodology. The Netherlands, Norway and Sweden, which also used their own methods, did so partially.

6. All Parties which did not use CORINAIR provided a description of how *feedstocks* had been considered. For those using CORINAIR this description is superfluous. Only five Parties (BEL, FRA, GBR, NLD, NOR) properly followed the guidelines by including CO_2 emissions from fossil-fuel based products in *fuel combustion* and excluding CO_2 emissions from organic biogenic products from the *waste* category. This deviation from the IPCC guidelines, although common, practically does not affect the aggregated CO_2 emission estimates.

7. The IPCC guidelines specify that if the reference approach for estimation of CO_2 emissions from *fuel combustion* is used, the worksheets from the energy module in the workbook substitute the standard data table. The guidelines also request the use of the energy reference approach for those Parties which estimate their inventory using the sectoral approach or other compatible methodologies for verification purposes. The United Kingdom made these comparisons for the whole period 1990-1995 and Germany for 1990-1993. Germany indicated that it will compare 1994-1995 inventories also, once the national energy balance for those years is completed. The Czech Republic, the Netherlands and the United States of America compared their methods with the IPCC reference approach for the base year and Finland for 1994. For the majority of these cases the reported differences fall within 1 to 3 per cent, demonstrating the usefulness of this approach for verification purposes. This comparison is requested by the IPCC guidelines but not all Parties followed them.

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[2]CORINAIR is the component dealing with air emissions inventories of the European Community CORINE (Co-ordinated Information System on the State of National Resources and Environment). CORINAIR is also used for reporting under the UN ECE Convention on Long-range Transboundary Air Pollution.

[3]Belgium also used a top-down methodology to compile the inventory for some regions.

8. Data for CO_2 emissions from *fuel combustion* were consistent with other authoritative sources of country-specific estimates. For 11 out of 17 reporting Parties, estimates of CO_2 emissions from *fuel combustion* for 1990 were within 5 per cent of the recent estimates made by the International Energy Agency (IEA)[4]. Six Parties, for which differences were larger, used CORINAIR or other methodologies of their own. However, once the CO_2 emissions from *international aviation bunkers* are excluded from the IEA data for all reporting Parties and the emissions from *feedstocks* are included in the *fuel combustion* category for those six Parties (in line with a top-down approach), all the estimates fall within 5 per cent of the IEA data.

9. Several Parties provided documentation to supplement their second national communication or their inventories previously submitted yearly, aimed at documenting the methods used or the deviation from the IPCC guidelines. The scope of this documentation, however, differed widely among Parties.

10. None of the reporting Parties provided the worksheets or equivalent information on *agricultural soils* and *land-use change and forestry* requested by the FCCC guidelines. It is not clear for what reasons this information was not submitted. One possible explanation might be that the reporting guidelines and methodologies for these sectors require further elaboration.

11. The FCCC guidelines do not provide clear instructions on what documentation equivalent to the IPCC worksheets should be submitted for the *energy* or other source categories by Parties using CORINAIR or other methods. It has not been clearly defined what supporting documentation needs to be attached to the annual submissions of GHG emission inventories.

12. To achieve transparency in the inventory data, the IPCC worksheets or equivalent information for all source and sink categories are required. As of 1998 Annex I Parties will submit their annual inventories using the 1996 IPCC revised guidelines, which do not require attaching the IPCC standard data tables any more. It is therefore necessary to define what type of "equivalent information" will have to be submitted to the secretariat by those Parties which compiled their inventory using methodology other than that of the IPCC. It would also be useful to compare estimates of the CO_2 emissions originating in *fuel combustion* with the IPCC reference approach as requested in the IPCC guidelines. These two issues might require direct reference in the FCCC guidelines.

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[4]International Energy Agency, *CO_2 emissions from fuel consumption*, 1997 edition (forthcoming). OECD, Paris.

C. Completeness

13. Data for the majority of emissions were comparable, in particular on a gas-by-gas basis, yet many Parties departed from the IPCC guidelines by defining source and sink categories differently or omitting emissions and/or categories included by other Parties. Differing definitions of source and sink categories affect the comparison of emission factors and increase uncertainty in estimating and reporting emissions, but they do not affect the comparability of the aggregated GHG emissions reported by Parties. Omissions and exclusions of some sources do affect the comparability.

14. The degree of completeness of GHG emission estimates varies widely among reporting Parties. Nevertheless, the data are more complete than in the first national communications, especially in the *industrial processes* category.

All Parties reported emissions for:

CO_2 from *fuel combustion* and *industrial processes*
CH_4 from *enteric fermentation*, *animal waste* and *waste*
N_2O from *agricultural soils*

Almost all Parties reported emissions for:

CH_4 in the form of *fugitive fuel* emissions and from *fuel combustion*
N_2O from *industrial processes* and *fuel combustion* (mainly *transport*)

15. Reporting of emissions from other source categories was less complete, especially for *land-use change and forestry*. The lower level of reporting of CO_2 emissions from *iron and steel*, *non-ferrous metals* and *inorganic chemicals* categories is apparently due to the fact that many Parties reported these emissions in the *fuel combustion* category. In general, the lower level of reporting may be explained by the main factors. First, some types of activities do not exist in all Parties (e.g. *rice cultivation* or *coal mining*). Secondly, some Parties lack reliable activity data for those activities which are common to all of them (e.g. *traditional biomass burnt for energy*) or the available methodologies produce highly uncertain results (e.g. CO_2 emissions from *agricultural soils*, or N_2O emissions from *wastewater treatment*).

D. Confidence levels

16. Eight Parties (BEL, CAN, CZE, GBR, NLD, NZL, SLO, USA) provided quantitative information on levels of uncertainty, either on a gas-by-gas basis or at the source/sink category level as requested by the FCCC guidelines. Eight Parties (CHE, FIN, GBR, ICE, NLD, SLO, SWE, USA) also provided a self-assessment of the completeness and quality of their inventories using the IPCC recommended format. Five Parties (AUT, DEU, FRA, IRE, NOR) either did not provide estimates of uncertainties or did so partially. Three Parties (CAN, GBR, USA) provided

a detailed analysis of the assumptions used to estimate uncertainties and New Zealand did so for CO_2 energy-related emissions.

17. Table II contains an overview of the reported uncertainty estimates. Although the reporting varied widely among Parties, it is clear that Parties made substantial efforts to follow the guidelines. This resulted in improved information compared to the first national communications. The qualitative and quantitative information made available by Parties may be summarized as follows:

GHG	Confidence level	Remarks
CO_2	"High" for *fuel combustion* and *industrial processes*. Predominantly "medium" for *changes in forest and other woody biomass stocks* subcategory, with two Parties reporting them as "low". "Low" for other subcategories of *land-use change and forestry* .	"High" for *energy* and *industrial processes* estimates has an error range of less than 10 per cent. "Medium" for these categories has an error range between 10 and 35 per cent.
CH_4	"Medium" for *fugitive fue* emissions.. Predominantly "medium" for *fuel combustion, enteric fermentation, animal waste* and *waste*, with some Parties reporting them as "low".	"Medium" for these categories has an error range between 20 and 50 per cent.
N_2O	Predominantly "high" and "medium" for *industrial processes*, with two Parties reporting them as "low". Predominantly "low" for *fuel combustion*, with some Parties reporting them as "medium". All Parties reported "low" for *agricultural soils*.	"Low" for these categories has an error range between 50 to more than 100 per cent.

18. Only Canada, Iceland and the Netherlands estimated uncertainties for HFCs, PFCs and SF_6 ranging from "medium" and ±50 per cent to a factor of two.

19. Parties were consistent in reporting emissions from those main source and sink categories which in 1990 accounted for about 98 per cent of their total GHG emissions expressed in CO_2 equivalent, using 1995 Intergovernmental Panel on Climate Change (IPCC) global warming potentials (GWP). For 83 per cent of the total 1990 GHG emissions the highest confidence level was reported. Other sources having high or medium confidence levels accounted for an additional 13 per cent of emissions. When the emission estimates are compared over a period of time, the resulting relative confidence level is generally higher than for the estimates for individual years. The fact that 96 per cent of emissions were reported as having a high or medium confidence level may therefore be regarded as an adequate basis for assessment of implementation of Article 4(a) and (b).

E. Recalculation of the base year inventory

20. Almost all Parties, submitting a second national communication, had recalculated their base year inventory and the subsequent inventories. Parties, which at the time of writing only submitted their inventory information for the years subsequent to 1990, also did so. At least one of these latter Parties used for the recalculation a method different from that used for estimating the base year inventory, yet without recalculating the baseline.

21. As can be seen in table III, the differences between the previously and recently submitted figures are in many cases significant. This is true both for estimates made on a gas-by-gas basis and for those expressed in terms of CO_2 equivalent. For the most part, changes to the base year were motivated by the desire of Parties to calculate their emission estimates more accurately. As methodologies develop, both nationally and internationally, the collection of data improves (emission factors, activity data and methods) and new emission sources are included.

22. The Subsidiary Body on Scientific and Technological Advice (SBSTA), at its fourth session decided that, to ensure comparability, Parties should recalculate the base year inventory and inventories for any subsequent years when using the 1996 IPCC revised guidelines. According to the same decision, the revised guidelines should be used as of 1998 on a mandatory basis. The SBSTA decision, however, does not indicate how to deal with the changes in the estimates introduced for reasons other than the use of the revised guidelines.

23. The estimation of GHG emissions using methods, emission factors and activity data other than those which were used for the base year inventory could complicate comparison of the target and base year figures. To avoid this complication the recalculation has to be carried out in a consistent and transparent way, so that the baseline and target year estimates are *de facto* comparable. This issue deserves special attention in the light of annual submissions, as requested by decision 9/CP.2, and might require direct reference in the FCCC guidelines.

F. The use of global warming potentials (GWPs)

24. Table III demonstrates the magnitude of changes in emission estimates introduced by the 1995 IPCC GWPs used in accordance with the revised FCCC guidelines instead of the 1994 IPCC GWP used by the majority of Parties in their first national communications. The use of different GWPs values (with the same time horizon) for the estimation of total GHG emissions expressed in terms of CO_2 equivalent could have a significant influence on the estimates, even if the difference between the GWP values is small. This influence depends on the shares of individual GHGs in the total emissions.

25. Since 1990, the IPCC, as a result of ongoing scientific research, has updated the GWP values four times. It is likely that this refinement process will continue. Moreover, the relative importance of individual greenhouse gases will vary in the future as their atmospheric concentration changes. Therefore, the GWP values will continue changing in the future

influencing both the base and target year estimates. The FCCC guidelines do not address this issue yet since reporting of total GHG estimates in terms of CO_2 equivalents is optional.

G. Emissions from the *land-use change and forestry* sector

26. None of the problems with the comparability of CO_2 emission estimates from this sector identified in the compilation and synthesis of first national communications appear to be resolved. The information provided did not shed additional light on various assumptions related to the definitions of anthropogenic activities and their treatment for emission reporting purposes. In general, Parties did not specify whether their forests are totally managed or not.

27. All reporting Parties, except Canada and Iceland, presented estimates of CO_2 emissions from *land-use change and forestry*. Methods used to estimate emissions and sinks still differ widely, with some Parties using their own methods or models rather than the IPCC methodology. Only nine Parties presented the emissions from this sector using the IPCC standard data tables. Canada stated that it was not possible to report the estimates in a fashion that fits the IPCC inventory framework, but provided a detailed description of the model used for estimation and preliminary estimates of the carbon fluxes in Canadian forests. Iceland did not provide a formal estimate either but presented an approximate figure instead. Five Parties (CHE, DEU, FIN, NOR, NZL) pointed out that the current IPCC methodology based on the forest harvest considers potential emissions only. Some of them expressed the view that this potential approach ignores the carbon sequestered in wood products as well as the time-lag between the harvest and emissions from tree parts left in the forest. These emissions may be significant when summed over decades. Some Parties also noted that the effect of exports and imports of wood products is ignored under the IPCC approach.

28. However, *changes in forests and other woody biomass stocks*, the main subcategory for almost all Parties, were covered well. Data were provided by 15 Parties, although assumptions sometimes differed. In all cases this subcategory constituted a sink. In general, Parties classified the confidence level of these estimates as medium. The situation is different for other subcategories: *forest and grassland conversion* was reported by four and *abandonment of managed land* by three Parties only. Some Parties indicated that these emissions are negligible, while others did not provide any explanation. In all cases, the estimates were reported as having low reliability.

29. Comparison and aggregation of emissions and removals from *land-use change and forestry* was complicated by scientific uncertainties, difficulties in data collection and differing coverage. Further research and methodological work is needed to ensure that estimation and reporting is done in a consistent, transparent and comparable manner. However, the information provided indicates that these goals could first be achieved in the *changes in forests and other woody biomass stocks* subcategory owing to its better coverage and to the medium confidence level reported for these estimates.

H. Reporting of other GHGs (HFCs, PFCs and SF_6)

30. Reporting the emissions of these gases on a mandatory basis is a new requirement of the FCCC guidelines which was properly followed by all Parties. The SBSTA, at its sixth session, encouraged Parties to report both actual and potential emissions of these gases. Neither the FCCC guidelines nor SBSTA decisions require reporting emissions of these substances in a disaggregated way, indicating the different types of chemicals in the inventories.

31. The differences between GWP values for different types of HFC and PFC species are large. The differences between the values of emission factors based on different rates of release to the atmosphere are also large. Therefore, estimates for aggregated and disaggregated emissions and for actual and potential emissions can also vary to a significant degree depending on the mix of different types of HFCs and PFCs.

32. Seven out of 15 Parties which reported HFC emissions did not provide disaggregated figures for them. Eight Parties provided potential and three actual emission estimates; for the remaining four it is not clear what approach was used. Only Canada provided both potential and actual emission estimates, indicating that their ratio is 6:1. Similar problems with reporting were identified with PFCs and SF_6.

33. Both potential and actual approaches provide useful information and could be incorporated in the FCCC guidelines. It might be useful to amend the conclusions on reporting emissions of these gases adopted by the SBSTA at its fourth session in a way which would give precise guidance on submitting disaggregated inventories of these "new" gases using both the actual and the potential approach on a mandatory basis.

Table I. Reporting of inventory data on energy sector

Parties	IPCC standard data tables provided	Worksheets or equivalent information provided	Activity data and disaggreg. emission factors	Correspond-ence with IPCC source categories	Description of how feedstocks were considered	Comparison with the reference approach
		(For Parties which used a top-down approach)	(For Parties which used CORINAIR or other bottom-up approach)			(Requested by IPCC guidelines)
AUT	No	-----	No	No	----	No
BEL	Yes	No	No	Yes	Yes	No
CAN	Yes	No	---	----	Yes	---
CHE	Yes	----	No	Yes	----	No
CZE	Yes	Yes	----	----	Yes	---
DEU	Yes	Yes	----	---	Yes	Yes
FIN	Yes	1994 only	---	---	Yes	Yes (1994)
FRA	Yes	----	No	Yes	----	No
GBR	Yes	Yes	Yes	Yes	Yes	Yes
ICE	Yes	No	-----	------	Yes	No
IRL	1993 only	----	No	No	---	No
NLD	Yes	No	---	---	Yes	Yes (1990)
NZL	Yes	No	---	----	Yes	No
NOR	No	No	No	Yes	Yes	No
SLO	Yes	Yes	----	-----	Yes	---
SWE	Yes	No	No	Yes	Yes	No
USA	Yes	No	----	-----	Yes	Yes (1990)

Table II. Confidence levels[a] (qualitative[b] or quantitative (± per cent)) of GHG emission estimates in the main source and sink categories

Gas and Source/sink	BEL	CAN	CHE	CZE	FIN	GBR	ICE	NLD	NZL	SLO	SWE	USA
CO_2	2	4[d]	H	8-10	H-M	**H 5**	**H**	**H 2**	**5**	**H 10**	**H-M**	**H**
Fuel combustion		3	H	H-M	H	**H**	**H**	**H**		H	H	H 1-2
Industrial processes		15	H		H	**H**	**H**	**H**		M	M	H
Changes in forest[e]	25		H			**L 15**		**M**	**25**	H 35		L
Other LUCh^F[f]						**L 50**			**35**	M		L
CH_4	**30**	**30[d]**	**M**	**40**	**M/L**	**M 20**	**M/L**	**M 25**	**50**	**M/L 30-50**	**M/H**	**M/L**
Fuel combustion		40	M	20-30	L	L	M	M		L	M	M
Fugitive: oil & gas		30	M	20-30	M	M		M		M		L
: coal mining		40		40-50		M				M		H 20[g]
Enteric fermentation		30-50	M	20-30	M	M	M	M		M	H	M 20
Waste animal		50	M	20 -30	M	M	L	L		M	M	M
Waste		30	M		M	L	L	M		M-L	M	M-L 20
N_2O	**50**	**40[d]**	**M/L**	**80-100**	**M**	**H/L**	**L**	**L 50**	**50**	**L >100**	**L**	**H/L[h]**
Fuel combustion		50-60	M		M	L	L	L		L	L	L
Inorganic chemicals		30	M		M	H		L				H[h]
Organic chemicals		15				H				L	L	H[h]
Agricultural soils		60-100	L		M	L	L	L		L	L	L

[a] The secretariat uses the term "confidence levels" to compile consistently data presented by Parties using different terms: uncertainties, emissions range, accuracy, etc.

[b] High (H); Medium (M); Low (L). When different benchmarks were reported for the same GHG, the predominant figure is pointed out using a "bold" letter.

[c] Reported uncertainties in this row correspond to CO_2 emissions excluding *land-use change and forestry*.

[d] The emissions range presented by Canada has a different confidence level: 95, 90 and 85 per cent for CO_2, CH_4 and N_2O, respectively.

[e] *Change in forest and other woody biomass stock* subcategory.

[f] Other subcategories of *land-use change and forestry* category.

[g] The uncertainty of 20 per cent refers only to underground mining ventilation systems; the uncertainty for surface mining is about 100-300 per cent.

[h] Party assigned High confidence level to the uncertainty related to N_2O industrial process emissions but did not specify whether this assignation corresponds to inorganic chemicals or organic chemicals category. In order to present the data consistently the secretariat assigned H to both categories.

Table III. Differences in GHG emission estimates for 1990 (base year) due to the subsequent revision/updating of the data, (percentage change)[a]

	CO_2	CH_4	N_2O	All GHG emission estimates (CO_2 equivalent)		
				Total change[b]	Effect of the use of 1995 GWP's[c]	Effect of changes in methodology and /or data[d]
AUT	[+4.5][e]	-2.6	[+183]	3.4	-2.9	6.4
CAN	<1	<1	-10	-1.9	-2	0.1
CHE	-	[-26.6]	-26	-7.6	-2.2	-5.5
CZE	<1	-5.7	7.5	-2.3	-1.8	-0.5
DEU	-	-	7	-2.5	-1.8	-0.7
FIN	<1	-2.4	-18.2	-3.8	-1.6	-2.2
FRA	[+3.2]	+4.1	+2.8	1.9	-2.4	4.4
GBR	1.2	-1.5	+10.8	-0.8	-2.3	1.5
ICE	-1.1	[-39.1]	-33.3	-10.7	-2.7	-8.1
IRE	-	+1.9	[-30.6]	-10.8	-5	-6.1
NLD	-	+4.1	<1	0.7	-2	2.7
NOR	<1	[+48.9]	-	3.4	-2.2	5.8
NZL	-	[-14.1]	[+178]	-3.8	-8.9	5.5
SLO	[+3]	[+17.9]	-21.9	1.5	-1.9	3.5
SWE	[-9.5]	<1	-39.5	-12.1	-1.7	-10.5
USA[f]					-1.7	

[a] Percentage deviation relative to the inventory submitted in the first national communication. Negative values denote that the latest submitted inventory gives a lower figure. All figures are rounded.

[b] This change represents the effect of all introduced changes, including the effect of the use of different GWPs (with the same time-horizon = 100 years) and the effects of changes in methodology and/or data. The number given in this column is not always a sum of the two columns to the right due to rounding.

[c] In the second national communications IPCC 1995 GWPs were used, whereas IPCC 1994 GWPs were used in the first communications. To estimate the effect of this change data given in the first national communications were adjusted using 1995 GWPs. (Data with 1994 GWP = 100 per cent).

[d] This change represents the effects of changes in methodology and/ or data. The effect of the use of different GWPs in the first and second national communications is excluded here.

[e] [ ] Each of these differences could cause a change higher than 2 per cent in the aggregated emissions estimates of all GHGs of the Party expressed in terms of CO_2 equivalent, excluding land use-change, in relation to the previous 1990 reported inventory (base year).

[f] Estimation from the USA is not presented here because the necessary data are not provided in the second national communication.

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